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Y Chromosome Polymorphism in the Bank vole *Clethrionomys glareolus* (Rodentia, Mammalia)

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The genus *Clethrionomys* is characterized by a uniform karyotype concerning number and morphology of chromosomes and also G-bands distribution (Nadler et al. 1976; Zima and Kral 1984; Yoshida et al. 1989). All species examined had the same diploid number 2 n = 56 with all chromosomes being acrocentric of gradually decreasing size except one pair of small metacentrics, thus FNa being 56. In all species the X chromosome is among the largest acrocentrics in the karyotype. The only differences at the chromosomal level found between species and populations concern the morphology of the Y chromosome. Yoshida et al. (1989) found three types of Y chromosome in 7 species of the genus *Clethrionomys* from Japanese islands. In the bank vole, *Clethrionomys glareolus* the Y chromosome is a small metacentric in most cases (Matthey and Renaud 1935; Hsu and Benirschke 1970; Vorontsov et al. 1978). However, Savić et al. (1968) and Žiković et al. (1975) found acrocentric Y chromosomes in some specimens from former Yugoslavia. Acrocentric Y chromosomes were also found by Kral et al. (1972) at Monte Gargano, Italy, which led them to the conclusion that two types of Y chromosomes are connected with the distribution of different subspecies. However, Radosavljević et al. (1988) found animals in one population on Jastrebac mountain in former Yugoslavia with acrocentric and submetacentric Y chromosomes. The aim of this study was to further investigate polymorphism of the Y chromosome in this species.

A total of 80 males of *Clethrionomys glareolus* were caught in "Longworth" traps at the following localities in former Yugoslavia: Cer (CQ84) 17, Jastrebac (EP30) 27, Goč (DP82) 5, Kopaonik (DN88) 17, Mokrec (VL68) 3, Snježnik (VL63) 1, Šara (EM06) 5, Travna Gora (VL76) 3, Tara (CP66) 2 (Coordinates of UTM system are given in brackets). Chromosome preparation was done directly from bone marrow using standard procedure. G-bands were obtained according to the modified schedule of Seabright (1971) and C-bands with an adopted method of Summer (1972). Chromosome analyses where done on 20 metaphases for each specimen.

All animals studied had the same karyotype 2 n = 56 and NFa = 56. Differences were established only in the morphology of the Y chromosome. Y chromosomes were among the smallest in the karyotype, being about one-fourth of the X chromosome size. Two types of Y chromosomes were found (Tab. 1). The metacentric type was found in 47 animals (58.8%) and remaining 41.2% had acrocentric Y chromosomes. Both types of Y chromosomes appeared almost entirely heterochromatic after C-banding (Fig. 1). G-bands did not provide any further information about differences between the two types of Y chromosomes due to their small size.

Table 1. Types of Y chromosomes in *Clethrionomys glareolus* at different localities (f-m – frequency of metacentric Y).

Locality	metacentric Y	acrocentric Y	N	f-m
1. Mokrec	–	3	3	0.00
2. Snježnik	–	1	1	0.00
3. Travna Gora	–	3	3	0.00
4. Cer	3	14	17	0.18
5. Goč	2	3	5	0.40
6. Šara	4	1	5	0.80
7. Jastrebac	22	5	27	0.81
8. Kopaonik	14	3	17	0.82
9. Tara	2	–	2	1.00
Total	**47**	**33**	**80**	**0.59**

Three localities were represented with a greater number of animals (Kopaonik, Jastrebac and Cer) and in all of them intrapopulational polymorphism of the Y chromosome was present. At Kopaonik and Jastrebac metacentrics predominated (Fig. 2). The frequency of metacentrics was 0.81 for Jastrebac and 0.82 for Kopaonik. However, the ratio of metacentric (0.18) and acrocentric chromosomes at Cer differed significantly from those at Kopaonik ($X^2 = 4.24$, $p < 0.001$) and Jastrebac ($X^2 = 7.33$, $p < 0.001$). Although the samples from Šara and Goč were considerably smaller, the presence of the two forms was also revealed. At three localities from northwest only acrocentrics were found, while Tara was characterized by metacentrics only.

In most of the cases where polymorphism of the Y chromosome was found in mammals the size of the Y chromosome and the amount of constitutive heterochromatine was variable. This phenomenon is well-known in man (Borgoankar 1977), and in some rodents as well.

In the genus *Clethrionomys* polymorphism of the Y chromosome is connected with different morphological forms. Besides *C. glareolus*, different types of Y chromosomes, acrocentric and metacentric, characterize populations of *C. rutilus* and *C. rufocanus*. In both species the metacentric type predominates. In *C. rutilus* acrocentrics were found only in populations south of Siberia (Vorontsov et al. 1978). Acrocentric Y chromosomes characterize populations of *C. rufocanus* from Japanese islands (Hsu and Benirschke 1969; Yoshida et al. 1989), Mongolia (Orlov et al. 1978) and Sweden (Gamperl 1982). However, on the Japanese islands differences occur at the species level in the 7 species of *Clethrionomys* (Yoshida et al. 1979). Three of them are characterized by metacentric Y, other three by acrocentric and only one by subtelocentric Y. No intraspecific variation of Y was found. A dendrogram constructed from allozyme data for these species was consistent with the distribution of the variants of the Y chromosome.

In *C. glareolus*, like in *C. rutilus* and *C. rufocanus* the acrocentric form of Y chromosome is limited in its distribution. Besides some parts of former Yugoslavia it includes only Monte Gargano in Italy. Vorontsov et. al. (1980) concluded that the variants of Y are fixed in isolated populations near the borders of species ranges. We found populations with one form of Y (acrocentric) only in the northwest part of ormer Yugoslavia. All others, except one, had two types of Y. Metacentric Y predominate in all samples except on Cer which is closest to the northwest localities.

There exists a trend of increase of metacentric Y chromosomes from the northwest to the southeast.

It could be supposed that the presence of different types of Y chromosomes at the same localities resulted from a secondary contact of previously isolated populations (or subspecies). This contact may have been a postglacial event.

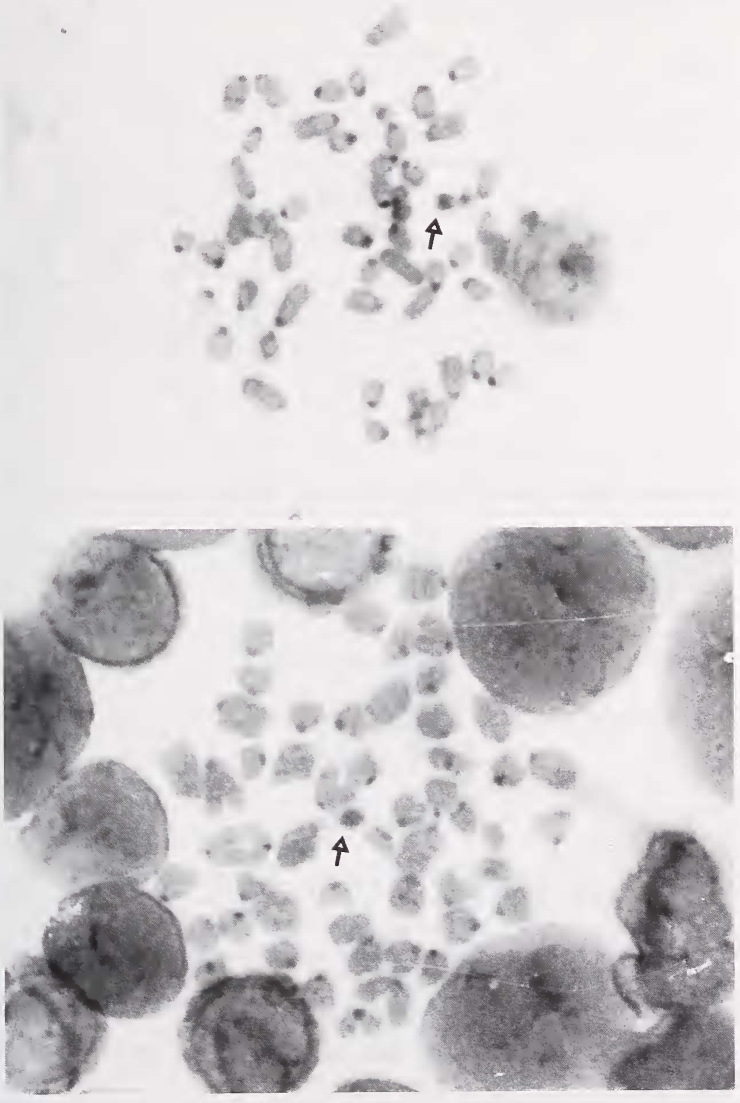

Fig. 1. C-banded metaphases of *C. glareolus* with metacentric (a) and acrocentric (b) Y chromosome (marked with asterisk).

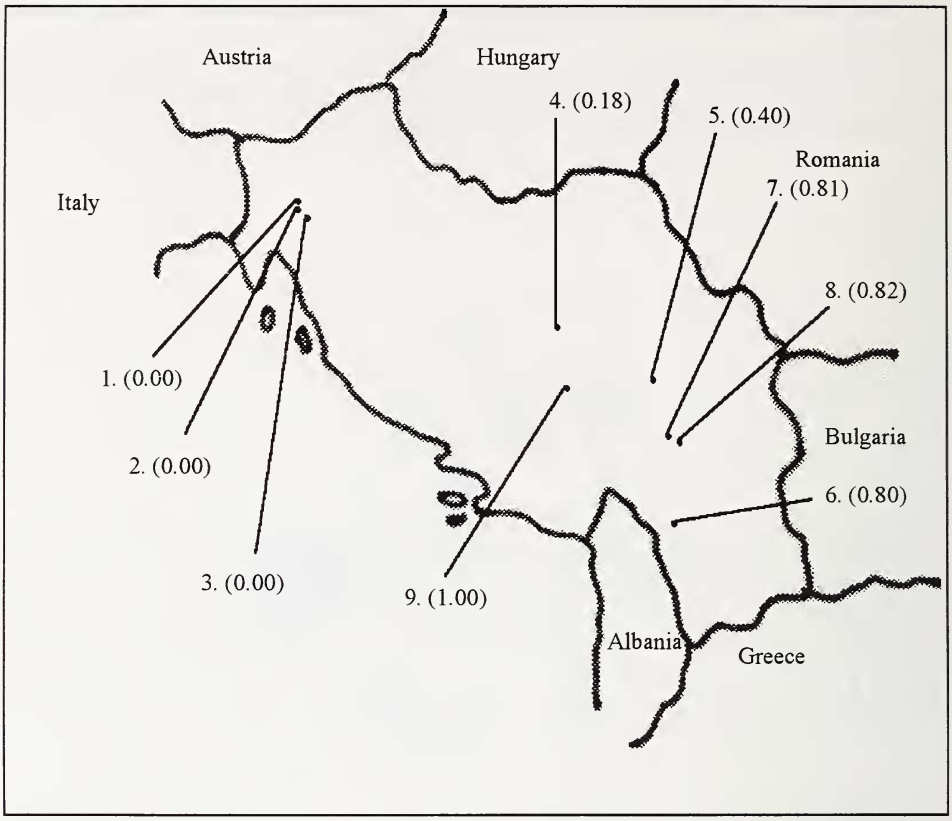

Fig. 2. Frequency of metacentric Y chromosomes at different localities in former Yugoslavia (names of localities given in Tab. 1).

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